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Preliminary Analysis of Resource Recovery Alternative for Fayetteville, Tennessee

CSI Resource Systems, Inc.
Boston, MA

Prepared for

Environmental Protection Agency
Atlanta, GA

Aug 81

U.S. Department of Commerce
National Technical Information Service

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This report analyzes the economic feasibility of potential resource recovery facilities in Fayetteville, Tennessee. Both current solid waste resources and local industry needs were assessed. Economic projections were then developed for 50, 72, and 100 tons per day modular combustion resource recovery systems.

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EPA

A TECHNICAL ASSISTANCE PROGRAM REPORT

Preliminary Analysis of Resource Recovery Alternative for Fayetteville, Tennessee

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Technical assistance by personnel teams. 42 USC 6913

RESOURCE RECOVERY AND CONSERVATION PANELS

SEC. 2003. The Administrator shall provide teams of personnel, including Federal, State, and local employees or contractors (hereinafter referred to as "Resource Conservation and Recovery Panels") to provide States and local governments upon request with technical assistance on solid waste management, resource recovery, and resource conservation. Such teams shall include technical, marketing, financial, and institutional specialists, and the services of such teams shall be provided without charge to States or local governments.

This report has been reviewed by the Project Officer, EPA, and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

Project Officer: Elmer G. Cleveland

U. S. ENVIRONMENTAL PROTECTION AGENCY

TECHNICAL ASSISTANCE PROGRAM REPORT SERIES

PRELIMINARY ANALYSIS

OF

RESOURCE RECOVERY ALTERNATIVES

FOR

FAYETTEVILLE, TENNESSEE

PREPARED FOR

OFFICE OF SOLID WASTE MANAGEMENT

U. S. ENVIRONMENTAL PROTECTION AGENCY

REGION IV, ATLANTA, GEORGIA

BY

CSI RESOURCE SYSTEMS, INC

AUGUST 1981

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PHASE I - LETTER REPORT

TECHNICAL ASSISTANCE TO FAYETTEVILLE, TENNESSEE

BACKGROUND

Analysis has been performed to determine the economic feasibility of various sized resource recovery facilities to convert the solid waste from Fayetteville, Tennessee and surrounding areas into low-pressure process steam for the Amana Corporation, a Fayetteville industrial concern. A recently completed TVA preliminary fesibility study* identified Amana as a potential customer for resource recovered steam According to this study, Amana utilizes 120 psi process steam in its manufacturing operations. Average hourly steam demand is ±15,000 pounds on a 24 hour, 5 day per week basis. The average steam demand represents the energy equivalent of 80 TPD_5 of MSW. Although preliminary indications are that Fayetteville's currently available solid waste resources are on the order of 40 tons per day, on a 5-day basis, system capital cost projections and resulting annual cost and revenue projections (for years 1984 through 1989) were developed for 50-, 72- and 100-tons per day (TPD) modular combustion resource recovery systems. The rationale for evaluating the two larger systems is the possibility that additional volumes of solid waste can be attracted from surrounding communities (which, like Fayetteville, are facing increasingly expensive landfill disposal). It is felt that these communities would be willing to participate in a regional resource recovery facility, provided the cost of such a disposal alternative can be cost-competitive with their option of continued landfilling.

FINDINGS

The following table presents the first and sixth year projected economics of three modular combustion resource recovery systems ranging in size from 50 to 100 TPD on a 5-day operating basis.

*"Potential for Resource Recovery from Municipal Solid Waste in the Duck and Elk River Areas"

Resource Recovery System (Daily Design Capacity)	Average Daily Throughput (5-Day Basis)	Projected Per-Ton Disposal Cost 1984	1989
50	45	$48.03	$46.40
72	65	$38.79	$34.77
100	90	$23.80	$17.80

First-order economics developed for the 50-TPD_5 modular combustion system indicate first-year (1984) net disposal costs of $48.03 per ton and sixth-year (1989) costs of $46.40. The 72-$TPD_5$ system indicates disposal costs of $38.79 and $34.77 per ton for 1984 and 1989. The 100-TPD_5 modular combustion system projects 1984 disposal costs of $23.80 and 1989 costs of $17.80 per ton.

In developing the annual cost projections the assumption was made that the increase in energy revenues (10% per year) would exceed the general inflation rate (8% per year) by 2%; that the facility would enjoy a high utilization factor (i.e., all energy produced would be sold) and that energy would be sold at its non-discounted fuel-equivalent value. To the extent that any of these generally optimistic assumptions did not hold true, the projected cost of disposal would further increase.

Clearly, the cost projections for each size resource recovery facility exceeds the likely cost of continued landfilling for Fayetteville. Current landfill disposal costs, including transportation, are in the $10-per-ton range. Assuming a 10% annual escalation in the cost of operating the existing landfill indicates 1984 and 1989 approximate disposal costs of $13 and $16 per ton for disposal under continual landfilling.

As can be seen by the attached analysis, the economic viability of resource recovery at the 50-to-100-TPD_5 range is extremely sensitive to annual throughput. From 50-to-100 TPD_5 of process capacity there are definite economies of scale in terms of both capital costs and labor. The labor requirements for both 72-TPD_5 and 100-TPD_5 modular combustion systems are projected at 11 personnel; staffing for the 50 TPD_5 system is only reduced by two workers to 9 total personnel.

ASSUMPTIONS

The following assumptions were used in developing the first-order economics for the each resource recovery facility:

- Resource recovery system becomes operational in 1984.
- Costs including capital and annual operational costs escalate at 8% compounded.
- 1984 steam revenues of approximately $6.65/1,000 pounds of 120 psi steam are predicated upon current estimated gas costs of $3.56/1,000 cubic feet and an assumed 85% boiler efficiency.
- Energy prices escalate at 10% per year.

NEXT STEPS

The attached analysis indicates that resource recovery in the 50-to-100-TPD_5 range is unlikely to be a cost-competitive solid waste disposal option for Fayetteville, Tennessee at this time. However, one major caveat must be noted. Because the economic feasibility of resource recovery is directly related to the fuel displacement value of the energy produced, major shifts in energy prices could modify this conclusion. In the case of Fayetteville natural gas, a regulated commodity and hence an artificially priced fuel, forms the basis for our analysis. At its current price of $3.65/1,000 ft^3 natural gas is priced at the equivalent of 51¢/gallon for #6 oil. As #6 oil currently sells for between 75¢ and 90¢ per gallon, natural gas is underpriced anywhere from 46% to 76%.

Due to this major institutional uncertainty as to whether, and when, natural gas prices will be deregulated, it is recommended that Fayetteville monitor natural gas pricing developments. In the event that natural gas deregulation occurs or for other reasons natural gas prices rise at a rate greatly above the general inflation rate, the economic feasibility of resource recovery should be reassessed.

PROJECTED CAPITAL COSTS
FOR MODULAR COMBUSTION SYSTEMS
(1984 Basis)

DESIGN CAPACITY	50 TPD_5	72 TPD_5	100 TPD_5
AVERAGE THROUGHPUT	45 TPD_5	65 TPD_5	90 TPD_5
CAPITAL COST COMPONENTS:			
Site Acquisition & Development	$ 120,000	$ 120,000	$ 120,000
Building	784,000	784,000	784,000
Combustion Subsystems	1,642,000	2,230,000	2,394,000
Mobile Equipment	60,000	80,000	80,000
Start-up, Acceptance and Contingency	248,000	309,000	325,000
Engineering & Construction Management	194,000	241,000	254,000
Financing Expense	129,000	159,000	168,000
Debt Service Reserve	566,000	698,000	734,000
Capitalized Interest	559,000	691,000	726,000
TOTAL BOND ISSUE	$4,302,000	$5,312,000	$5,585,000

PROJECTED ECONOMICS FOR 50 TPD_5
MODULAR COMBUSTION SYSTEM

ANNUAL SOLID WASTE THROUGHPUT (tons)	11,700
ANNUAL ENERGY SALES (pounds of steam)	52,650,000

EXPENSE ITEM ($/ton)	OPERATING YEAR	
	1 (1984)	6 (1989)
Debt Service	$48.33	$ 48.33
O&M	27.43	40.30
Residual Disposal	3.00	4.41
Operator's Fee	5.00	7.35
SUBTOTAL	83.76	$100.39
REVENUES ($/ton)		
Steam	29.93	48.19
Debt Service Reserve Earnings	5.80	5.80
SUBTOTAL	35.73	53.99
REQUIRED TIP FEE ($/ton)	48.03	46.40

PROJECTED ECONOMICS FOR 72 TPD_5
MODULAR COMBUSTION SYSTEM

ANNUAL SOLID WASTE THROUGHPUT (tons)	16,848
ANNUAL ENERGY SALES (pounds of steam)	75,816,000

EXPENSE ITEM ($/ton)	OPERATING YEAR	
	1 (1984)	6 (1989)
Debt Service	$41.13	$41.13
O&M	23.83	35.01
Residual Disposal	3.00	4.41
Operator's Fee	5.00	7.35
SUBTOTAL	72.96	87.90
REVENUES ($/ton)		
Steam	29.93	48.19
Debt Service Reserve Earnings	4.94	4.94
SUBTOTAL	34.87	53.13
REQUIRED TIP FEE ($/ton)	$38.09	$34.77

PROJECTED ECONOMICS FOR 100 TPD_5
MODULAR COMBUSTION SYSTEM

ANNUAL SOLID WASTE THROUGHPUT (tons)	23,400
ANNUAL ENERGY SALES (pounds of steam)	105,300,000

EXPENSE ITEM ($/ton)	OPERATING YEAR	
	1 (1984)	6 (1989)
Debt Service	$31.37	$31.37
O&M	19.12	28.09
Residual Disposal	3.00	4.41
Operator's Fee	4.00	5.88
SUBTOTAL	57.49	69.75
REVENUES ($/ton)		
Steam	29.93	48.19
Debt Service Reserve Earnings	3.76	3.76
SUBTOTAL	33.69	51.95
REQUIRED TIP FEE ($/ton)	$23.80	$17.80

Personnel Requirements for 50 TPD[5] Modular Combustion System

Position	No. of Employees	Employee Salary	Total
Plant Manager	1	$25,000	$25,000
Shift Manager	2	19,000	38,000
Scale Operator	1	14,000	14,000
Operators	4	14,000	56,000
Maintenance Mechanic	1	17,500	17,500
Total	9		$150,500
Fringe Benefits @33%			$ 49,665
TOTAL LABOR EXPENSE			$200,165
Projected Labor Expense in First Year of Operation[1]			$239,075

1. Increased at 8% per year to 1984.

Personnel Requirements for 72 and 100 TPD[5] Modular Combustion Systems

Position	No. of Employees	Employee Salary	Total
Plant Manager	1	$25,000	$25,000
Shift Manager	2	19,000	38,000
Scale Operator	1	14,000	14,000
Operators	6	14,000	84,000
Maintenance Mechanic	1	17,500	17,500
Total	11		$178,500
Fringe Benefit @33%			$ 58,905
TOTAL LABOR EXPENSE			$237,405
Projected Labor Expense in First Year of Operation[1]			$283,555

1. Increased at 8% per year to 1984.

JOB EPA: FAYETTEVILLE, TENN.

SHEET NO. 1 OF 6

CALCULATED BY DST DATE 7/31/81

CHECKED BY DEO DATE 8/10/81

SCALE

PROJECT CONFIGURATIONS

CASE 1: 50 TPD (1-50 TPD INCINERATOR + 1 BOILER)

CASE 2: 72 TPD (2-36 TPD INCINERATOR + 1 BOILER)

CASE 3: 100 TPD (2-50 TPD INCINERATOR + 1 BOILER)

COMBUSTION SYSTEM COST

CASE 1: $1,250,000 REFERENCE: CONSUMAT SYSTEM AUGUST 1981 $

CASE 2: $1,735,000

CASE 3: $1,870,000

TOTAL STAFFING

CASE 1: 9 REFERENCE: CONSUMAT SYSTEM

CASE 2: 11

CASE 3: 11

AVAILABILITY

AVAILABLE FOR OPS: 24 HRS. x 5 DAY x 52 WEEK = 6240 HPY

SCHEDULED OUTAGE: 24 HRS x 5 DAY x 2 WEEK = 240 HPY

FORCED OUTAGE: 8 HRS x 1 DAY x 25 WEEK = 200 HPY

ACTUAL OPERATION = 5800 HPY

AVAILABILITY = 92.95%

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ASSUMED AVAILABILITY FOR ANALYSIS PURPOSES = 90%

JOB EPA: FAYETTEVILLE, TENN.

SHEET NO 2 OF 6

CALCULATED BY DST DATE 7/31/91

CHECKED BY DEC DATE 8/10/91

SCALE

THROUGHPUT

CASE 1: 50 TPD x 260 DPY x 90% AVAIL. = 11,700 TPY

CASE 2: 72 TPD x 260 DPY x 90% AVAIL. = 16,848 TPY

CASE 3: 100 TPD x 260 DPY x 90% AVAIL. = 23,400 TPY

ENERGY ASSUMPTIONS

4,500 BTU/LB. MSW x 60% RECOVERY (EFFICIENCY) = 2,700 BTU/LB MSW

2,700 BTU/LB MSW x 2,000 LB/TON = 5,400,000 BTU/TON MSW

5,400,000 BTU/TON MSW ÷ 1,162 BTU/LB STEAM = 4,647 LB STEAM/TON MSW

ASSUME 4,500 LB STEAM/TON MSW FOR ANALYSIS PURPOSES.

TOTAL STEAM AVAILABLE FOR SALE PER YEAR

CASE 1: 11,700 TPY x 4,500 LB STEAM = 52,650,000 LB STEAM

CASE 2: 16,848 TPY x 4,500 " = 75,816,000 LB STEAM

CASE 3: 23,400 TPY x 4,500 " = 105,300,000 LB STEAM

AVERAGE STEAM RAISING RATE

CASE 1: 52,650,000 LB STEAM ÷ 5,800 HPY = 9,078 LB STM/HR

CASE 2: 75,816,000 LB STEAM ÷ 5,800 HPY = 13,072 LB STM/HR

CASE 3: 105,300,000 LB STEAM ÷ 5,800 HPY = 18,155 LB STM/HR

JOB EPA: FAYETTEVILLE, TENN.

SHEET NO 3 OF 6

CALCULATED BY DST DATE 7/31/81

CHECKED BY DEC DATE 8/10/81

SCALE

PROJECT SCHEDULE

ASSUME 16 MONTHS FROM THE DATE OF FINANCING TO THE SCHEDULED ACCEPTANCE DATE.

AUGUST, 1981	CURRENT DOLLARS
SEPTEMBER 1, 1982	FINANCING DATE
MARCH 1, 1983	MID-POINT OF CONSTRUCTION
SEPTEMBER 1, 1983	COMPLETE CONSTRUCTION
SEP - NOV, 1983	START-UP
DECEMBER, 1983	TESTING
JANUARY 1, 1984	BEGIN OPERATIONS

JOB EPA: FAYETTEVILLE, TENN.
SHEET NO 4 OF 6
CALCULATED BY DST DATE 7/21/21
CHECKED BY DEO DATE 8/10/21
SCALE

(A) Site Acquisition and Development

3 acres
$10,000/acre to purchase
$25,000/acre to develop

$30,000
75,000
$105,000

$105,000 x 1.10 = $115,500 (escalate from 8/81 to 8/80)

assume $120,000 for all 3 cases.

(B) Building

$40/ft² assumed 1983 dollars

16,200 ft² (135 x 120) processing building
3,400 ft² — steel frame ash office

19,600 ft² x $40/ft² = $784,000

assume $784,000 for all 3 cases

(C) Combustion Subsystems

Case 1: 1,250,000 x [(1.08)(1.08)(1.04)] = 1,516,320

Case 2: 1,735,000 x [1.213056] = 2,104,652

Case 3: 1,870,000 x [1.213056] = 2,268,414

escalate from 8/81 to 3/23.

JOB EPA: FAYETTEVILLE, TENN.
SHEET NO 5 OF 6
CALCULATED BY DST DATE 7/31/81
CHECKED BY DEO DATE 8/10/81
SCALE

(D) Mobile Equipment

Case 1: assume $60,000 in 1983 $

Case 2: assume $80,000 in 1983 $

Case 3: assume $80,000 in 1983 $

(E) Start-ups, acceptance and contingency

10% of items A thru D

Case 1: 248,032

Case 2: 308,865

Case 3: 325,241

(F) Engineering and Construction Management

8% of items A thru C

Case 1: 193,625

Case 2: 240,692

Case 3: 253,793

JOB EDA: FAYETTEVILLE TENN.

SHEET NO 6 OF 6

CALCULATED BY DST DATE 7/31/18

CHECKED BY DEO DATE 8/10/21

SCALE

120,000		120,000		120,000	
784,000		784,000		784,000	
~~1,577,000~~	1,642,000	~~2,165,000~~	2,230,000	~~2,269,000~~	2,394,000
60,000		80,000		80,000	
248,000		309,000		325,000	
194,000		241,000		254,000	
~~2,923,000~~	3,048,000	~~3,639,000~~	3,764,000	~~3,832,000~~	3,957,000

(G) + (H) + (I)

Case 1: $X = 2{,}923{,}000 + (.03)(x) + (1.3)(.1)(x) + (.13147)(x)$

$X = 2{,}923{,}000 + (.29147)(x)$

$(.70853)(x) =$ ~~2,583,000~~ 3,048,000

$X =$ ~~4,125,442~~ 4,301,864

FE = 123,763 ≈ ~~124,000~~ 129,000

CR = 542,372 ≈ ~~543,000~~ 566,000 ~~4,125,000~~

CI = 536,305 ≈ ~~536,000~~ 559,000 4,302,000

Case 2: $X = 3{,}764{,}000 - (.29147)(x)$

$X =$ ~~5,135,986~~ 5,312,407

FE = 154,080 ≈ ~~154,000~~ 159,000

CR = 675,228 ≈ ~~675,000~~ 698,000 ~~5,136,000~~

CI = 667,678 ≈ ~~668,000~~ 691,000 5,312,000

Case 3: $X = 3{,}957{,}000 + (.29147)(x)$

$X =$ ~~5,406,581~~ 5,584,802

FE = 162,251 ≈ ~~162,000~~ 168,000

CR = 711,040 ≈ ~~711,000~~ 734,000 ~~5,406,000~~

CI = 703,090 ≈ ~~703,000~~ 726,000 5,585,000